Remarks

Claims 1-3, 7-12, 14, 17-32, and 36-44 of the application were rejected and remain for consideration by the Examiner. Claims 4-6, 13, 15, 16, and 33-35 were previously withdrawn from consideration by the Examiner as drawn to nonelected species. The Examiner agreed with Applicant's previous arguments that claim 1 is generic with respect to claims 1-42 and claim 39 is generic with respect to claim 40-42.

Applicant greatly appreciates the Examiner's time given for the interview on August 13, 2003. The arguments herein include those presented in the interview.

The Examiner stated in paragraph 1 of the current Office Action that "Applicant's arguments with respect to claim 1-3, 7-12, 14, 17-32, and 36-44 have been considered but are moot in view of the new ground(s) of rejection." The Applicant submits that for claims 8-11, 18-32, and 36-43 there were no new grounds for rejection presented or new references cited by the Examiner. The Examiner's text in the Office Action rejecting these claims reads exactly the same as the prior Office Action. Accordingly, please note that the arguments set forth below are the same as those in the prior Office Action response, and are repeated herein for convenience for the Examiner's consideration.

Claim Rejections – 35 USC § 103 – Ghoshal in view of Osakabe

The Examiner rejected claims 1, 2, 3, 7, 12, 17, and 43 under 35 U.S.C. 103(a) as being obvious with respect to Ghoshal US Patent No. 6,474,074 in view of Osakabe US Patent No. US 2001/0023758 A1. These claims are nonobvious in that there is no *prima facie* case of obviousness.

1. Independent claims 1 and 43

Claims 1 and 43, as previously presented, require an evaporator that is "substantially full" of liquid coolant. The Examiner states that "it would be obvious to modify Ghoshal's invention by providing a liquid coolant substantially filling the evaporator in order to increase the cooling process." Ghoshal, however, cannot be combined with Osakabe to result in a substantially full evaporator. The liquid coolant, or transport fluid, of Ghoshal, can only partially fill the Ghoshal evaporator based on Ghoshal's operating principles. Ghoshal teaches away from a substantially full evaporator by requiring that there be vapor in the evaporator region, which is transported by the vapor channels 235 (see col. 4, lines 38-41).

Ghoshal would not function if the transport fluid substantially filled the evaporator region; if it did, not only would there be no void available for vapor in the evaporator, but the condenser region would also be substantially full of transport fluid. Ghoshal lacks the ability to have a substantially full evaporator region, and doing so would render Ghoshal unsatisfactory for its intended purpose. Ghoshal as modified with a substantially full evaporator of Osakabe also has no likelihood of success.

Ghoshal is a heat pipe design that operates by fluid return from the condenser to the evaporator by the wicking action of the capillary action. To remove the capillary region by combination with Osakabe would change the principle of operation of Ghoshal, and there is no motivation or suggestion to combine the references.

Claims 1 and 43 require that there be a condenser "extending around the periphery of the evaporator." Ghoshal, on the other hand, requires a capillary region 220 in between the evaporator region 210 and condenser region 225. (See Ghoshal Figure 2.) Nor does Osakabe have a condenser extending around the periphery of its refrigerant vessel 32 (See Osakabe Figure 11.) The modification of Ghoshal to include a peripheral condenser would change its principle of operation. Both references lack the limitation of a peripheral condenser.

In summary, the modification or combination of Ghoshal in view of Osakabe does not provide a *prima facie* case of obviousness because it:

- fails to provide a reasonable expectation of success;
- fails to provide suggestion or motivation to modify or combine the references; and
- fails to teach or suggest all claim limitations.

Claims 1 and 43 are nonobvious over Ghoshal in view of Osakabe.

2. Dependent claims 2, 3, 7, 12, and 17

Because claims 2, 3, 7, and 12 depend from allowable claim 1 as amended and respectively add limitations thereto, these claims are allowable. Claim 17 depends from claim 12, which depends from claim 1, and is therefore allowable for the same reason. For additional reasons set forth below, claims 7 and 17 are allowable.

2.a. Claim 7

The boiling enhancement structure of the Applicant's invention is "a porous component that provides re-entrant cavities" (see p. 10, lines 20-21). Neither Ghoshal nor Osakabe teach or suggest such a claim limitation.

Ghoshal has "hot point" elements 250, which are disclosed as conically shaped (see col. 4, lines 9-15). Alternatively, they may be pyramidal, or any shape terminating at a tapered point (see col. 4, lines 31-37), and are so required in order to function in accordance with Ghoshal's invention. *"Any configuration may be used as long as the hot points terminate at a tapered point"* (see col. 4, lines 34-36; emphasis added; see also Ghoshal independent claims 1, 21, and 29, all requiring hot point elements). The Ghoshal hot point elements are structurally and functionally different from Applicant's boiling enhancement structure.

Osakabe discloses inner fins 34 "formed with plural recess portions 34a to increase a heat transfer area (boiling area)" (see ¶ 0072, lines 4-6). Osakabe does not provide re-entrant cavities in with its inner fins, which therefore differ from Applicant's boiling enhancement structure.

Further, the evaporation process of Ghoshal is a surface phenomenon and does not involve the formation of vapor bubbles that form in Osakabe. This is one reason why there needs to be only a thin layer of liquid region in the evaporator section of Ghoshal's device for it to function properly. Excess liquid at high heat fluxes results in

bubble formation that might block the capillaries and prevent the return of liquid from the condenser to the evaporator, known as the "boiling limit" in heat pipes, and needs to be avoided in Ghoshal. The is no likelihood of success in modifying Ghoshal in view of Osakabe, nor is there any suggestion to modify or combine the teachings of prior art.

There being no *prima facie* case of obviousness, claim 7 is nonobvious with respect to Ghoshal in view of Osakabe.

2.b. Claim 17

Claim 17 recites a thermosyphon that has a full evaporator when horizontal and the first plate is above the second plate. Contrary to the Examiner's assertion, it would not be obvious to modify Ghoshal's invention by providing a liquid coolant substantially filling the evaporator to increase the cooling process. As discussed above, Ghoshal cannot function with a full operator. Ghoshal's Figure 2 does not show *any* fluid in between its first and second substrates 230, 240. Presumably, Ghoshal's evaporator does include some fluid. As discussed above, however, with respect to claim 7 and amended claims 1 and 43, the liquid coolant, or transport fluid, of Ghoshal only partially fills the evaporator in a thin layer, and Ghoshal does not teach or suggest a substantially full evaporator in any orientation. To the contrary, Ghoshal requires that there be vapor in the evaporator region that is transported by the vapor channels 235 (see col. 4, lines 38-41; col. 5, lines 22-26). Ghoshal would not function if the transport fluid filled the evaporator region; if it did, not only would there be no void available for vapor in the evaporator, but the condenser region would also be full of transport fluid. Ghoshal

lacks the ability to have a full evaporator region, and accordingly would be rendered unsatisfactory for its intended purpose if its evaporator were full.

Ghoshal cannot be modified in view of Osakabe and still function. Nor is there any suggestion of motivation in prior art to combine the references. Claim 17 is nonobvious with respect to Ghoshal in view of Osakabe.

Claim Rejections - 35 USC §103 – Ghoshal and Anderson

The Examiner rejected claims 8-11, 18-22, 25, 32, and 39-42 under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Ghoshal US Patent No. 6,474,074 and Anderson et al. US Patent No. 5,761,0327.

3. Independent claims 39 and 41

Claim 39 recites a thermosyphon having a substantially full evaporator at all orientations, with performance also being substantially independent of orientation. Claim 41 recites such a thermosyphon as part of a cooling enhanced electronic component.

The Examiner incorrectly asserts that Anderson states that its evaporator is substantially full of liquid coolant over a range of angles. Rather, Anderson states that the *wicking member/manifold 102* is *operable* with respect to any orientation (see col. 4, lines 3-5 and 33-38). Anderson's wicking manifold operates through capillary action in the wicking structure, and purports to spread the liquid, indicating that the evaporator region is less than full. To state that the wicking member/manifold is operable at any angle does not mean that the evaporator is substantially full at any angle. Keeping the

evaporator substantially full is not disclosed in either reference. Anderson discloses nothing about how to keep an evaporator substantially full at any orientation, and neither does Ghoshal, since in Ghoshal the evaporator cannot be substantially full and still function.

The present invention, however, teaches a thermosyphon that is substantially full at all orientations. None of the cited references teach or suggest such a design criterion.

There is no motivation or suggestion to combine Ghoshal and Anderson, nor is there any expectation of success, as Ghoshal cannot have a substantially full evaporator and have performance that is orientation-dependent, and the combination does not teach or suggest all the claim limitations. As no *prima facie* case of obviousness exists, claims 39 and 41 are nonobvious and allowable over the combination of Ghoshal and Anderson.

4. Dependent claims 8-11, 18-22, 25, 32, 40, and 42

Because claims 8-11, 18-22, 25, and 32 depend from allowable claim 1 as amended through one or more other allowable claims, claim 40 depends from allowable claim 39, and claim 42 depends from allowable claim 41, and respectively add limitations thereto, these claims are allowable. For additional reasons set forth below that demonstrate that there is no *prima facie* case of obviousness, claims 8, 11, 18-22, 25, 32, 40, 42, are allowable.

4.a. Claim 8

A grooved boiling enhancement structure is provided in claim 8. There is no suggestion or motivation to combine Ghoshal and Anderson to achieve Applicant's invention. As previously stated for claim 7 in paragraph 2.a. above, in Ghoshal *"Any configuration may be used as long as the hot points terminate at a tapered point"* (see col. 4, lines 34-36; emphasis added; see also Ghoshal's independent claims (1, 21, and 29), all requiring hot point elements 250). Ghoshal therefore prohibits the use of Anderson's structure, and claim 8 is nonobvious in view of the cited references.

In addition, Anderson's wicking manifold 102 is used to spread liquid in the evaporator, and is purportedly able to do this at any orientation. Applicant's structure, however, is used mainly for trapping vapor to provide active nucleation sites for boiling, and is not used to ensure orientation independent performance of the thermosyphon heat spreader. There is no suggestion in either Ghoshal or Anderson to combine Anderson's structure for spreading liquid to make a site for vapor nucleation. Again, claim 8 is nonobvious.

4.b. Claim 11

Claim 11 recites a boiling enhancement structure of open-celled foam. For similar reasons as those discussed for claim 8 in paragraph 4.a. above, Ghoshal cannot

be combined with Anderson to include such a structure in place of its "hot point" elements 250. Accordingly, claim 11 is nonobvious in view of the cited references.

4.c. Claims 18-22, 25, 32, 40, 42

These claims relate to the level of liquid in the evaporator for various orientations. Please refer to paragraph 3 above. For the same reasons as those given for claims 39 and 41 in paragraph 3, these claims are nonobvious and allowable.

Claim Rejections - 35 USC §103 – Ghoshal and Paal

The Examiner rejected claim 14 under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Ghoshal US Patent No. 6,474,074 and Paal US Patent No. 5,051,814. Claim 14 is allowable as it depends from allowable claim 12, which depends from allowable claim 1, and adds limitations thereto. Further, Ghoshal and Paal cannot successfully be combined. Paal's method for enhancing heat removal is in a plane perpendicular to the plane of the heat-dissipating device, contrary to Ghoshal.

Claim Rejections - 35 USC §103 – Ghoshal and Brzezinski

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Ghoshal US Patent No. 6,474,074 and Brzezinski US Patent No. 5,323,292. Claim 23 depends from allowable claims 12 and then 1, and adds limitations thereto. For this and the reasons below that show there is no *prima facie* case of obviousness, claim 23 is allowable over the cited references.

5. Claim 23

Brzezinski does not include an evaporator or evaporator plate, contrary to the Examiner's assertion. Instead there are two heat sinks provided (see Figure 1; col. 3, line 62 to col. 4, line 4 (two heat sinks); col. 5, lines 29-38 (thermally conductive fluid 58 fills the chamber formed by the first heat sink and the metallic membrane 56 – this is not an evaporator)). The fluid 58 provides a thermal path and does not evaporate.

Further Brzezinski does not disclose the walls as in claim 23. Claim 23 claims a condenser, which does not exist in Brzezinski, and more specifically, the cross-sectional shape of a condenser. Nor is such a shape disclosed in Ghoshal. This shape is shown in Applicant's figures 3, 7, 8, and 13. In addition, Brzezinski's method for enhancing heat removal is in a plane perpendicular to the plane of the heat-dissipating device, contrary to Ghoshal. The combined references lack all the limitations of claim 23, fail to motivate or suggest combining the references, and have no expectation of success in resulting in Applicant's invention. Accordingly, claim 23 in nonobvious in view of Ghoshal and Brzezinski.

Claim Rejections - 35 USC §103 – Design Choice

The Examiner rejected claims 24, 26, 29, and 36 on the basis of design choice. Because these claims depend from allowable claim 1 as amended through one or more other allowable claims, and respectively add limitations thereto, these claims are allow-

able. For additional reasons set forth below that show there is no *prima facie* case of obviousness, claims 26, 29, and 36 are allowable.

6. Claims 26, 29, 36

Planar shapes of rectangular (claim 28) and of square (claims 29 and 36) are asserted by the Examiner to be simply a matter of design choice. The Applicant is quoted as stating "the feature may be any shape as desired to suit a particular application or manufacturing advantage."

The above quote is true, but is taken out of context. In the application, it is included as a delimiting phrase to explain that a thermosyphon may have any planar shape and yet still fall within the scope of Applicant's invention if it meets other requirements.

A variety of planar shapes may be used in accordance with the present invention. To be an embodiment of the present invention according to claims 26, 29, and 36, however, a thermosyphon of any planar shape must have dimensions that keep the evaporator substantially full at any orientation. A planar shape has a great impact on the overall evaporator and condenser dimensions (outside the plane). Therefore, selecting a planar shape is not simply a matter of design choice.

Claim Rejections - 35 USC §103 – Ghoshal and Munekawa

The Examiner rejected claims 27, 28, 30, 31, 37, and 38 under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Ghoshal US Patent No. 6,474,074

and Munekawa et al. US Patent No. 5,076,351. Because claims 27, 28, 30, 31, 37, and 38 depend from allowable claim 1 as amended through one or more other allowable claims, and respectively add limitations thereto, these claims are allowable. These claims are also allowable for the additional reasons set forth below showing that there is no *prima facie* case of obviousness.

7. Claims 27, 28, 30, 31, 37, and 38

These claims provide dimensional requirements for thermosyphons according to the present invention. Munekawa is directed to a heat pipe and is inapplicable to Applicant's invention. The shapes of heat pipes may vary (see Applicant's application p. 2, lines 7-9). Evaporators and condensers in heat pipes may be sized as known to one of ordinary skill in the art. Unlike in Applicant's invention, Munekawa's condenser height is irrelevant to the liquid coolant volume and to the height of the evaporator. No liquid coolant resides in Munekawa's condenser. Further, the relationship between the Munekawa evaporator and the condenser has nothing to do with the orientation-independence of the heat pipe.

A variety of variables must be considered in order to size and fill the thermosyphon in accordance with Applicant's invention. Contrary to the Examiner's assertion, selecting the height of the condenser and evaporator, as well as the variables of evaporator and condenser lengths, is neither obvious nor routine skill in the art. None of the references cited by the Examiner teaches or suggests such a geometric configuration.

None has the purpose or result of providing an orientation-independent thermosyphon, achieved by maintaining a substantially full evaporator.

The combined references lack reference to limitations of these claims, and the subject matter between the two references is too different to be able to combine and achieve the Applicant's invention with any expectation of success. Nor is there any suggestion or motivation to combine the references. Claims 27, 28, 30, 31, 37, and 38 are nonobvious over the cited references.

Claim Rejections - 35 USC §103 – Ghoshal and Larson et al.

The Examiner rejected claim 44 under 35 U.S.C. 103(a) as being unpatentable over combined teachings of Ghoshal US Patent No. 6,474,074 and Larson et al. US Patent No. 5,704,416. Because claim 44 depends from allowable claim 43 and adds limitations thereto, this claim is allowable. This claim is also allowable for the additional reasons set forth below showing that there is no *prima facie* case of obviousness.

8. Dependent Claim 44.

Claim 44 provides that there be a void in the evaporator to allow the heat-dissipating element to directly contact the liquid coolant. The Examiner stated that Larson discloses such a void, citing column 8, lines 38-47. It is respectfully submitted that the Examiner was incorrect in this assertion. Nowhere in Larson (or in Ghoshal), is a void in the evaporator disclosed. The cited text in Larson merely teaches use of a clip to fasten a chip to an evaporator. There is no void in the evaporator or direct liquid

contact with the chip. Similarly in Ghoshal, the heat-dissipating element ("chip") is placed in contact with the bottom of the evaporator ("substrate" 240, Figure 3). Both references lack a void, and do not teach or suggest all of the limitations of claim 44. Claim 44 is nonobvious as the references do not teach or suggest all of the claim limitations, and further do not suggest or provide motivation to modify the substrate.

If the Examiner has any questions about the present Reply, a telephone interview is respectfully requested.

As the rejections entered by the Examiner in the Official Action dated June 17, 2003 have been shown to be inapplicable, reconsideration and allowance of claims 1-3, 7-12, 14, 17-32, and 36-44, and passage of these claims to issue, is hereby respectfully requested. Further, as the Examiner previously agreed that allowable claim 1 is generic with respect to claims 1-42 and allowable claim 39 is generic with respect to claims 40-42, it is requested that the withdrawn claims be reconsidered and passed to issue.

Respectfully submitted,

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